

## ***Proposed Minimum Water Level Criteria for the Lower West Coast Aquifer System within the South Florida Water Management District***

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### **I. INTRODUCTION**

It is the intent of the South Florida Water Management District (SFWMD) to ensure that all planning documents produced by staff are based on sound scientific principles and information. To this end, a panel of technical experts was assembled to review the draft document titled ***Proposed Minimum Water Level Criteria for the Lower West Coast Aquifer System within the South Florida Water Management District***, hereafter referred to as the draft document.

#### **I.1 Charge to Panel**

The responsibility of the peer review panel was to review technical and scientific data, methodologies, and conclusions used to develop the Minimum Flows and Levels (MFL) criteria presented in the draft document as the Minimum Aquifer Levels (MALs) for the Lower West Coast aquifer system within the jurisdiction of the SFWMD. Pursuant to Section 373.042, F.S., water management districts must establish minimum levels for aquifers and surface water. The minimum water level, in the case of a MAL, is the level of groundwater (water table or potentiometric surface) in an aquifer at which further withdrawals would be “significantly harmful” to the water resources of the area. The objective of the technical peer review was an unbiased, science-based assessment of the draft document and the associated public input on the proposed MALs.

#### **I.2 Scope of Review**

The scope of the panel review included consideration of all scientific assumptions, data, and modeling processes and results. However, policy decisions and assumptions were expressly not subjects of the peer review process. Nevertheless, the panel was allowed to question the interaction of established SFWMD policy with technical decisions pertaining to the recommendation of MALs.

Three policy decisions or assumptions guided the development of the recommended MALs for the Lower West Coast aquifer system. These are: 1) protection of water resource functions, 2) identification of baseline resource conditions, and 3) the level of protection provided by the “Significant Harm” standard. The panel technical review was constrained to evaluation of the scientific soundness and defensibility of the recommended MALs within the context of these policy decisions.

The panel was required to review the proposed MALs for the Lower West Coast aquifer system giving specific attention to the “Significant Harm” standard of protection without challenging the definition of “Significant Harm”. “Significant Harm” is the loss of specific water resource functions that take multiple years to recover and result from a change in surface water or groundwater hydrology. While the panel may or may not agree with the aforementioned policy decisions, the technical peer review was conducted in accordance with the established policy.

### **I.3 Awareness and Acknowledgment of Public Comments**

The panel acknowledges that both oral and written public comment was provided during the comment period and at the Scientific Peer Review Panel Public Workshop held in Ft. Myers on September 28-29, 2000. The panel has reviewed and considered the public input in its findings and recommendations.

### **I.4 Organization of Panel Report**

The panel report on *Proposed Minimum Water Level Criteria for the Lower West Coast Aquifer System within the South Florida Water Management District* is organized into this introductory section followed by the findings of the panel based on independent review of the draft document and supporting materials, presentations by staff during the Scientific Peer Review Panel Public Workshop, open exchange among panelists during the workshop, and public input. Based on the panel findings, the panel makes specific recommendations. The recommendations pertain to both suggestions for improving the readability and understanding of the draft document, as well as, inclusions of additional considerations and discussions that may increase the scientific credibility and defensibility of the recommended MALs. The panel report concludes with a brief summary of the peer review panel’s overall assessment of the scientific basis and soundness of the proposed MALs for the Lower West Coast aquifer system.

## **II. FINDINGS**

Panel review of the draft document *Proposed Minimum Water Level Criteria for the Lower West Coast Aquifer System within the South Florida Water Management District* along with the input received during the public workshop has resulted in the following findings by the panel. According to the “Rules of the South Florida Water Management District Minimum Flows and Levels Chapter 40E-8.051 (Minimum Levels: Groundwater)” the Minimum Aquifer Levels for the Lower West Coast aquifer system are recommended as follows:

*Water levels in the lower Tamiami aquifer, the Sandstone aquifer and the mid-Hawthorn aquifer shall not fall below the structural top of the aquifer as measured in any non-pumping observation well on any day.*

## **II.1 Saltwater intrusion appears to be adequately accounted for by other regulatory means as relates to the MAL**

The problem of saltwater intrusion manifests itself in two ways:

1. Upconing of salt or brackish water underneath a well.
2. Horizontal inland movement of saltwater in an aquifer near the coast.

The problem of upconing underneath a well may occur over a period of only a few months, depending on the proximity of the fresh and saltwater interface to the bottom of the well. Staff should discuss the occurrence or absence of this situation in the Lower West Coast aquifer system. The horizontal movement of a saltwater wedge or its associated brackish water is usually a very slow process. It takes many years or decades to move saltwater landward over a significant distance. Under the current consumptive use permitting (CUP) program, rules are in place to prevent such long term saltwater intrusion into the Lower West Coast aquifers, at least into the Water Table Aquifer. Staff should explain this issue in detail and emphasize that the anticipated short duration of MALs is sufficient assurance that saltwater intrusion issues do not need to be considered.

## **II.2 Aquifer compaction and associated subsidence may be significant, but additional information, data, and analysis are necessary to confirm or deny this phenomenon**

The panel finds that compaction of the aquifer/aquitard systems and the resulting subsidence at land surface from lowering of the potentiometric surface may be significant. It is not possible at this time, however, to determine whether subsidence would actually occur. Calculations made by staff (see Appendix 1 of the draft document) indicate that there could be measurable subsidence due to lowering of the potentiometric surface. Much of the data used in these calculations were derived from the scientific literature, however, and are not site-specific to the Lower West Coast of Florida. Given the serious nature of land subsidence in urban areas, it would be prudent to further investigate this issue.

## **II.3 Compliance with and monitoring of the MALs are issues that need further consideration and discussion**

The panel believes that the geographic location and method of monitoring groundwater levels for compliance with, or exceedance of, the MAL is an important consideration. The panel understands the staff interpretation is that the MAL is exceeded if the potentiometric surface drops below the MAL at any instant in time. However, the ability to measure, or detect, such an occurrence needs greater consideration. If compliance monitoring is through pointwise surveillance via discrete monitoring wells, the density and location of the monitoring wells are critical concerns. The draft document statement (page 21) that “significant harm would occur...if water levels within any non-pumping observation well penetrating the aquifer, dropped below the structure top of the aquifer” does not suggest where the non-pumping observation well(s) would be located or the sampling frequency necessary to record such an occurrence. Presumably, the

observation wells would be located in or reasonably near pumping centers. However, given the spatial variability of potentiometric surfaces influenced by drawdown, the SFWMD must assure itself that the MALs are efficiently and effectively monitored throughout the Lower West Coast aquifer system. The MALs for the lower Tamiami, Sandstone and mid-Hawthorn aquifers will be surfaces with uneven topology (spatially varying) due to aquifer and semi-confining bed geometry. A well-designed and properly calibrated groundwater flow model could be used in conjunction with appropriately located observation wells to monitor compliance with the MALs.

#### **II.4 Duration, as well as, water level must be addressed in establishing MALs for surficial aquifer system**

Existing regulations are designed to avoid “harm” to the water resource functions of the Lower West Coast aquifer system and prevent “harm” to existing water rights and the environment. For instance, the CUP rules forbid drawdowns near wetlands (i.e., at the wetland boundary) of more than 1 foot. The MAL is intended to prevent “significant harm”. This may occur if drawdowns at the wetlands are lower than 1 foot. The panel believes, however, that the actual groundwater *level* underneath a wetland may be less of a concern than the *duration* of that low level. For instance, below some level (perhaps the 1 foot drawdown mentioned in the CUP) it may not matter anymore how low the groundwater level becomes, the wetland will dry up anyhow. What matters now is how long this situation persists. This adds a new dimension, that of time, to the MAL criteria that is not addressed in the current document. Staff should address this issue fully in a revised document.

#### **II.5 Interaction with other groundwater permitting programs should be addressed**

The panel understands that the recommended MAL for the lower Tamiami, Sandstone, and mid-Hawthorn aquifers is not the only groundwater protection program for the Lower West Coast aquifer system. The CUP program also affords a level of aquifer protection in terms of abating saltwater intrusion and minimizing the impact of aquifer and confining bed compaction, and hence subsidence. The CUP rules limit the cumulative reduction of the potentiometric surface in the lower Tamiami, Sandstone, and mid-Hawthorn aquifers to a “maximum developable limit (MDL)”. The MDL, established by rule, is to be approximately 40 feet above the structural top of the aquifer. No CUP will be issued that causes the potentiometric surface to drop below the MDL up to a 1 in 10 year drought condition. The draft document does not adequately address the relationship between the CUP (i.e., maximum developable limit) and the recommended MAL. The interaction between the CUP and the MAL as well as other groundwater protection programs such as wellhead protection should be more thoroughly explained in the draft document. As described in the draft document, the differences between and among these programs and the level of harm they address were the source of considerable confusion for the panel and presumably for the public, as well.

## **II.6 Potentially the most important MAL, that for the Water Table Aquifer, is not adequately addressed**

The panel has been asked to assess the correctness (scientific soundness) of the methods used to establish MAL criteria. The panel gathers from the draft document that the most important aquifer to be protected by a MAL is the Water Table Aquifer. The deeper aquifers are already adequately covered by existing regulations and “significant harm” is only anticipated in these (semi-confined) aquifers if the water table is being lowered below the confining layer. The “significant harm” in that event is the negative impact on water quality due to the shift from anaerobic to aerobic conditions in the unsaturated portion of the aquifer. The Water Table Aquifer, however, interacts with many surface water bodies, including environmentally sensitive wetlands. Low water levels in the Water Table Aquifer could potentially lead to “harm” or “significant harm” to the environment. Consequently, the establishment of MALs is most critical in the Water Table Aquifer. Yet, the current document defers the development of a MAL for that aquifer to some future date when “best available data” will become available. The panel notes that this situation excludes any meaningful review by the panel of the methods for establishing a MAL for the Water Table Aquifer.

## **II.7 Presentation of relevant data**

The panel believes that the draft document will better serve its intended purpose with additional data and/or data interpretation. The panel identified the following concerns.

### **II.7.1 Long-term potentiometric surface decline in the Intermediate Aquifer System**

Hydrographs for the Intermediate Aquifer System (see Figures 11, 12, and 13 in the draft document) show a consistent trend of declining water levels. It is not apparent from the report, however, whether this trend is wide-spread or local in nature. The report should document this trend more clearly and state whether these water level declines are representative of the whole region or just around pumping centers.

### **II.7.2 Impacts of withdrawals on the Water Table Aquifer is unsubstantiated**

The draft document references a joint venture between the SFWMD and the United State Army Corps of Engineers in connection with an analysis of surface water impacts from pumping in the Water Table Aquifer. It is not apparent from the text, however, what analyses were performed or what data were generated by this study that would be used in evaluating surface water impacts.

The draft document states that the “impact of withdrawals from the Water Table Aquifer was evaluated within a half-mile radius of these water bodies and is summarized in Figure 15 and Table 6.” The table in question lists the wells used in the evaluation but does not show what impacts were computed for these wells. Likewise, the figure shows well locations in relation to the surface water bodies but does not illustrate any impacts (e.g. drawdown contours or water level contours).

### **III. RECOMMENDATIONS**

Based on the peer review panel findings, the following recommendations for improvements in the draft document and the scientific foundation for the MALs are offered.

#### **III.1 Structure of the document**

The panel believes that the SFWMD would be well-served by making the draft document more complete and stand-alone. Specifically, the panel recommends that the draft document contain, in an Abstract or Executive Summary, a clear and precise definition of the MAL, the aquifers within the Lower West Coast aquifer system to which the MALs apply, and a summary of the scientific basis for the MAL. With this information provided at the outset, the reader will have a much better sense of the context within which to place the supporting technical and policy information that follows in the main body of the draft document. A schematic diagram of the MAL in relation to other groundwater permitting programs (e.g., CUP) should be added. Finally, the inclusion of data that are irrelevant to the establishment of the MAL or its explanation should be avoided. For example, the discussion at the top of page 18 of the draft document regarding the effect of a 50% reduction in the saturated thickness of an unconfined aquifer needs to be removed. Also, the relevancy of the water allocation data (Table 8) to establishing the MAL (which is based on water quality considerations) is unclear. It should be removed. The report contains many superfluous data that do not support (or detract from) the scientific basis of the MAL.

#### **III.2 Use of groundwater modeling**

One important aspect of “best available information” has been omitted from the bibliography of the draft document. Groundwater flow models have been prepared for Lee, Collier, and Hendry counties (see SFWMD reports DRE-287, DRE-307, and DRE-312). Groundwater models are ideally suited to answering some of the questions posed by the establishment of MFLs but model calculations are conspicuously absent from the draft document. The panel recommends that these models be used, or at least referenced, in the decision process for setting minimum water levels in each aquifer.

The models that have already been developed for the area can be used to look at surface water impacts on a large scale and on the interaction between the various aquifers. These models can also be used in the future as more water is pumped from the aquifer system to determine whether potentiometric surface declines would likely reach the minimum levels.

These models can also be used to further evaluate the degree of compaction that might result from large potentiometric surface declines. As pointed out in Appendix 1 of the draft document, the USGS MODFLOW model that was used for these three county-wide studies can also simulate aquifer compaction.

### **III.3 Documentation of saltwater intrusion prevention considered by regulatory means beyond MALs**

The panel realizes that staff considers the current regulations for the prevention of saltwater intrusion adequate to the point that it is not a criterion for MALs. Staff should substantiate this conclusion with a *comprehensive overview* of current regulations to this effect and clearly indicate how these regulations make saltwater intrusion criteria for MALs unnecessary. In doing so distinction should be made between the various aquifers and their saltwater intrusion characteristics (risks). For instance, an aquifer that pinches out toward the coast can only receive saltwater through leakage through a semi-confining layer. A deep aquifer with a fresh-saltwater interface that is (far) to the west of the coast line will be at a lesser risk than the Water Table Aquifer that exhibits saltwater inland from the coast. Differences in regulations and their relationship to a MAL should be made clear.

### **III.4 Field and laboratory research on subsidence/compaction**

The panel recommends that a research program be established to evaluate the potential for compaction/subsidence from potentiometric surface declines in the Lower West Coast aquifer system. Research activities should include the collection of field data from areas most likely to experience subsidence. These would be areas where the potentiometric surface declines have been the greatest. Field data should include establishing a network of surface monitoring points where subsidence could be monitored using standard surveying techniques. In addition, boreholes should be drilled for the purpose of collecting core samples. These samples can then be analyzed by a geotechnical laboratory to determine the compressibility of the different lithologies. Once the compressibilities have been measured, modeling or other calculations can be used to confirm the computations in Appendix 1.

### **III.5 Presentation of relevant data**

The panel believes that additional data presentations and interpretations will strengthen the scientific basis for establishing MALs in the lower Tamiami, Sandstone, and mid-Hawthorn aquifers. Specifically, the panel recommends the following data additions and/or interpretations be added to the draft document.

#### **III.5.1. Reasonable time series (historic or period of record to present) of potentiometric surfaces for surficial and Intermediate Aquifer systems should be included in the draft document.**

These data will provide additional indication of water table and potentiometric surface decline over time over broader areas than that provided by just plotting individual well hydrographs.

### **III.5.2 Locational maps for well hydrographs, pumping history for well hydrographs, and precipitation over the same time period should be plotted and included in the draft document.**

The well hydrographs should be presented in the draft document with additional supporting information and data to facilitate deeper understanding of the physical and anthropogenic influences on water level declines in the selected observation wells. It is important to know the pumping history in the vicinity of each well that gives rise to the decline along with the long term precipitation record over the period of the well hydrograph. These data should be over-plotted on the same graph for convenient interpretation. Finally, a map showing the location of each water level observation well in relation to other wells, especially production wells, should be included in the draft document.

### **III.6 Clear explanation of how the MAL will relate to protection of wetlands and other surface water bodies and related habitats (i.e., what recommendations and research will address this issue)**

Staff has indicated in the draft document that more research is needed before criteria for a MAL in the Water Table Aquifer can be established. Some reference is made to existing proposals, but no summaries of these proposals are provided. Little or nothing is said about how this research would lead to the establishment of MALs in the Water Table Aquifer, specifically how would it lead to avoidance of “significant harm” to water bodies and their environmental functions or to wetlands. Staff should outline the nature of the data that it feels are currently lacking, the type of research that would generate those data, and the type of analyses that would allow it to develop the MAL criteria. For instance, what fieldwork is being proposed? Is any modeling being proposed and how would that lead to the desired criteria? It seems that the link between “significant harm” and MALs in the Water Table Aquifer has not yet been thought through.

## **IV. SUMMARY**

The panel understands that the definition of “significant harm” is a policy issue beyond its purview. Therefore, the panel findings and recommendations implicitly accept the SFWMD definition of “significant harm” in its evaluation of the scientific soundness and scientific defensibility of the proposed minimum water level criteria for the Lower West Coast aquifer system within the South Florida Water Management District. The panel notes that the only MALs recommended in the draft document are for the lower Tamiami, Sandstone, and mid-Hawthorn aquifers. The decision on MALs for the Water Table Aquifer is delayed until further analyses are completed. The panel has commented on the establishment of MALs for the Water Table Aquifer. The panel concurs with staff that establishing MALs for the Floridan Aquifer System is unnecessary due to its projected low use compared to yield potential and its degraded water quality.



With regard to the MALs for the lower Tamiami, Sandstone, and mid-Hawthorn aquifers, the panel notes that the sole criterion for their establishment is water quality considerations. The SFWMD believes that “significant harm” will occur in these aquifers if the potentiometric surface is drawn below the structural tops of the aquifers thus converting a confined groundwater system to an unconfined aquifer at the location(s) where this situation occurs. The “significant harm” is interpreted as detrimental changes in water quality associated with conversion to aerobic conditions where previously anaerobic conditions existed. The SFWMD further states that such a phenomenon violates the MAL the instant it occurs, regardless of duration. Aquifer compaction and subsidence issues are presumably adequately addressed via other groundwater permitting programs where “maximum developable limits” are established well above the MAL to prevent serious, or even measurable, subsidence.

The panel believes that, in principle, the proposed MALs for the lower Tamiami, Sandstone, and mid-Hawthorn aquifers are scientifically sound without contesting the definition of “significant harm”. The panel further concludes that the water quality concern (i.e., conversion of anaerobic conditions to aerobic conditions) is legitimate and scientifically defensible. The panel does question, however, how long an aerobic condition (from a previously anaerobic condition) would have to exist over how broad an area to demonstrate “significant harm” from the perspective of loss of water resource function.